

THE SATURNIAN SATELLITE HYPERION.—The following positions are from Prof. Hall's elements in *Astron. Nach.*, No. 2.137. Mr. Common observed this very difficult object with his 18-inch silver-on-glass reflector on October 14, at 10h. 15m. G.M.T., when its position was  $92^{\circ}0'$  and distance  $208''$ ; the elements give  $93^{\circ}2'$  and  $208''$ . This satellite appears to be truly an *experimentum crucis* even for our large telescopes.

AT 8h. G.M.T.

Oct. 26	Pos. $276^{\circ}6'$	Dist. $222^{\circ}6'$	Nov. 3	Pos. $90^{\circ}6'$	Dist. $154^{\circ}5'$
" 27	" $277^{\circ}9'$	" $202^{\circ}6'$	" 4	" $92^{\circ}5'$	" $192^{\circ}2'$
" 28	" $279^{\circ}6'$	" $167^{\circ}5'$	" 5	" $93^{\circ}9'$	" $215^{\circ}8'$
" 29	" $282^{\circ}4'$	" $121^{\circ}3'$	" 6	" $95^{\circ}1'$	" $222^{\circ}4'$
" 30	" $289^{\circ}4'$	" $68^{\circ}1'$	" 7	" $95^{\circ}6'$	" $209^{\circ}8'$
" 31	" $340^{\circ}4'$	" $30^{\circ}8'$	" 8	" $97^{\circ}8'$	" $176^{\circ}3'$
Nov. 1	" $77^{\circ}1'$	" $53^{\circ}3'$	" 9	" $100^{\circ}4'$	" $124^{\circ}2'$
" 2	" $87^{\circ}2'$	" $106^{\circ}9'$	" 10	" $108^{\circ}1'$	" $58^{\circ}1'$

THE SATELLITE OF NEPTUNE.—The ephemeris subjoined is deduced from Prof. Newcomb's tables in the appendix to the Washington Observations for 1874:—

AT 11h. G.M.T.

Oct. 26	Pos. $221^{\circ}5'$	Dist. $16^{\circ}9'$	Nov. 3	Pos. $64^{\circ}8'$	Dist. $10^{\circ}7'$
" 27	" $194^{\circ}0'$	" $10^{\circ}5'$	" 4	" $37^{\circ}8'$	" $16^{\circ}9'$
" 28	" $72^{\circ}0'$	" $9^{\circ}2'$	" 5	" $1^{\circ}9'$	" $8^{\circ}3'$
" 29	" $40^{\circ}2'$	" $17^{\circ}0'$	" 6	" $241^{\circ}9'$	" $11^{\circ}4'$
" 30	" $10^{\circ}6'$	" $9^{\circ}8'$	" 7	" $216^{\circ}5'$	" $16^{\circ}8'$
" 31	" $248^{\circ}1'$	" $10^{\circ}0'$	" 8	" $176^{\circ}2'$	" $7^{\circ}6'$
Nov. 1	" $219^{\circ}0'$	" $17^{\circ}0'$	" 9	" $59^{\circ}2'$	" $12^{\circ}2'$
" 2	" $186^{\circ}6'$	" $9^{\circ}0'$	" 10	" $35^{\circ}3'$	" $16^{\circ}5'$

THE VARIABLE NEBULA IN TAURUS (G.C. No. 839).—Dr. Tempel gives some particulars of his examination of the neighbourhood of this object with the large Amici-telescope of the observatory at Arcetri, near Florence. Around the variable star which is close at hand (T Tauri of Prof. Schönfeld's Catalogue) a nebulous appearance was easily recognisable, but Dr. Tempel says he has remarked the same nebulous glimmer about other variable stars, amongst them in one of Goldschmidt's, which wholly disappears; in this case the glimmer is discernible before the star itself becomes visible. Near the variable star there are two small star-clusters, about which, however, there is no trace of nebosity in a telescope that is capable of resolving them. We believe changes in the disposition of nebosity near the variable star (which was only one minute of arc from the centre of the nebula at its discovery in October, 1852) were remarked some years since by Otto Struve with the Pulkowa refractor, but there has been no appearance of late, like that presented by the object in 1852, when it was conspicuous enough with a seven-inch aperture, which in 1863 and on several later occasions did not afford the least trace of it. The vicinity may be recommended for observation during the coming winter by those who are provided with instruments of sufficient grasp of light. Dr. Tempel has carefully delineated all the features that he has noticed with his large telescope for comparison with any other drawings that may be made by competent observers.

#### F. L. ALPHONS OPPENHEIM

PROF. OPPENHEIM, whose tragic fate was briefly alluded to a few weeks since, was born at Hamburg, February 14, 1833. In 1852 he graduated from the gymnasium there, and entered the University of Bonn. Here, and at Göttingen, he pursued a widely-extended course of scientific studies until 1857, when he passed the examination for Ph.D. at the last-named place. In the same year, after a short residence at the University of Heidelberg, he proceeded to London, where he carried out a number of researches in Prof. Williamson's laboratory. From here he went to Paris, where his chemical investigations were prosecuted in the laboratory of Prof. Wurtz

until 1867, when he returned to his native country and entered the University of Berlin as a privat-docent. This position was soon exchanged for that of an extraordinary professor, and early in the present year he accepted a call to the chair of chemistry in the Royal Academy of Münster. Just at the entrance of a career of widely-extended usefulness, while superintending the equipment of his new laboratory, a gloom was cast upon his path by the sudden decline of his wife, an English lady, to whom he was passionately attached. Months of watching and anxiety caused a condition of the most utter mental prostration. On September 16, within two hours of his wife's death, one of the deadliest drugs known to the chemist did its swift, painless work, and he was no more.

This sudden death has caused a feeling of sadness in an unusually large circle. Prof. Oppenheim was not only held in high esteem by the scientific men of his own country, but was warmly regarded by many leading chemists in France and England, while in the columns of this journal and in the meetings of the British Association his name became familiar to a more extended class. Prof. Oppenheim's chemical investigations are characterised chiefly by their variety, thoroughness, and theoretical value. We can only allude to his researches on tellurium and its compounds, the exhaustive monograph with F. Versmann on the application of saline solutions to render textile fabrics non-inflammable, the numerous papers on allylen and propylen derivatives, the extensive studies in the turpentine group, which yielded, among other results, the theoretical composition of cymene and the ethers of pyroracemic acid. During the past few years he carried out a number of interesting researches on the derivatives of aceto-acetic ether and its homologues, the most valuable of which were the discovery of oxyvitic acid with F. Pfaff and of propionyl-propionic ether with R. Hellon. As one of the founders of the German Chemical Society, and for many years its secretary, Prof. Oppenheim did much to contribute to the efficiency of this organisation and bring it to its present prosperity and widespread sphere of activity. Besides numerous contributions to contemporary scientific literature, he translated into German Odling's "Manual of Chemistry" and Wurtz' "History of Chemical Theories," the English edition of which, by Watts, is so well known.

Prof. Oppenheim's charming social qualities attracted to him friends in all ranks of society, and the literary and scientific celebrities of Berlin were often to be met at his table. The many foreign scientific students at Berlin who recall their hospitable welcome in his home will join with his friends in the feeling of grief over this abrupt termination to a career of such promising scientific usefulness.

T. H. N.

#### ELECTRIC LIGHTS FOR LIGHTHOUSES

REPORTS to the Trinity House have just been issued giving the results of some experiments made at the end of last year and the beginning of the present, by Prof. Tyndall and Mr. J. Douglass, Chief Engineer of the Trinity House, on the comparative value of various magneto-electric machines for lighthouse purposes.

The machines experimented on by Prof. Tyndall were the following:—(1) Holmes' machines, which have been already established for some years at the South Foreland; (2) Gramme's machines; (3) Two Gramme's machines coupled together; (4) Siemens' large machine; (5) Siemens' small machine.

Prof. Tyndall's observations were made on November 21 and 22 last year, from the Corporation's steamer *Galatea*, the position first chosen being not far from the Varne Light, and at a distance of  $11\frac{1}{2}$  miles from the lighthouses on the Foreland. Observations were subsequently made at various other distances.

In the first place, the new machines sending their currents to the Low Lighthouse were compared in succession with Holmes' machine, which produced its light in the High Lighthouse. Subsequently the new machines were pitted in pairs against each other—one of the two being in the High and the other in the Low Lighthouse. Care was taken in each instance to reverse their positions. Thus, whenever Siemens below was compared with Gramme above, the observation was immediately followed by a comparison of Siemens above with Gramme below, and so of the others. All irregularities arising from differences in the apparatus employed above and below were thus eliminated.

The following are the results of the observations on the nights of November 21 and 22:—The new machines mark a great advance, both in economy and power, as regards the application of the electric light to lighthouse purposes. Thus the machine of Holmes was found practically equalled by a single machine of Gramme, of considerably less volume and considerably smaller cost.

This discrepancy as to cost and volume was still greater in the case of the small Siemens machine, which yielded a light sensibly equal to that of Holmes'.

The single Gramme and the small Siemens machines are sensibly equal to each other, both of them producing an exceedingly fine light.

Prof. Tyndall was particularly impressed by the performance of the small machine of Siemens. Its power, in relation to its size, is surprising. The large machine of Siemens, however, greatly transcends both his small machine and the single machine of Gramme; it is sensibly equal to the two Gramme's machines coupled together, the price of the former being less than half that of the latter. The light from the large Siemens, as also that from the two coupled Grammes, is of extraordinary splendour. Siemens' and Gramme's inventions, Prof. Tyndall states, undoubtedly place at the disposal of the Elder Brethren electric lights of surpassing energy. Combining either the large machine of Siemens, the two Gramme's machines, or, if practicable, the two small machines of Siemens, with one of the group-flashing dioptric apparatus which have been recently devised by Dr. Hopkinson, a light transcending in power and individuality all other lights now existing would probably be obtained. Such a light would displace, with enormous advantage to the mariner, the two lights hitherto displayed at the Lizard. A fixed light, even should it be the electric light, at a distance is not to be distinguished from a ship-light or an ordinary shore-light near at hand.

On November 22 Prof. Tyndall visited the South Foreland, inspected the arrangement of the machines, and observed their light-producing power close at hand. In both Siemens' and Gramme's machines the induced currents are sent in a constant direction. One of the carbons is always positive, the other always negative—not alternately negative and positive as in the machine of Holmes. The positive carbon is heated more intensely and it wastes more rapidly than the negative one; its shape, moreover, is a point of some practical importance. From the positive to the negative carbon there is a transfer of particles which usually produces a crater-like hollow in the positive carbon. The concave surface of this crater is the place of most vivid incandescence, and it is easy to see that the radiation from that surface, when the positive carbon is the higher one, as it is in the arrangement at the South Foreland, would be directed to the earth. To obviate this inconvenience, the negative carbon is usually somewhat displaced, so as to cause the most vivid incandescence to occur on one side of the positive carbon. The portion of space towards which this side is turned receives from it a greatly augmented radiation. But the radiant power thus concentrated on one side is withdrawn from the other, which would be inadmissible if a whole circle had to be uniformly illuminated.

In most cases, however, only a portion of the entire circle is required; and no disadvantage arises from the weakening of the landward radiation.

If no valid mechanical grounds oppose the alteration, it would, Prof. Tyndall thinks, be a decided advantage to make the lower carbon the positive one. Its upward radiation would be utilised by the upper prisms to a far greater extent than its downward radiation is now utilised by the lower ones.

Mr. Douglass in his Report describes a series of experiments made during the first four months of the present year, the results obtained by him being essentially the same as those obtained by Prof. Tyndall. As in the November experiments, the various machines were pitted against each other. Messrs. Siemens' small-sized, or No. 58 machine had proved so satisfactory that they were asked to furnish a second one for the trials.

For the photometric measurement of the light the flame of the Trinity House 6-wick lamp, when consuming colza oil, was adopted as the standard. This lamp was placed at a distance of 100 feet from the electric lamp, and the measurements were taken by a Bunsen photometer. The 6-wick lamp was maintained, as nearly as practicable, at its intensity of 722 standard candles, and this intensity was checked from time to time by candle measurements taken with a separate Sugg photometer.

Mr. Douglass refers in some detail to the greater consumption in the top-carbon of the Gramme and Siemens machines than in the other machines. A portion of the light is thus prevented from being fully utilised in the extreme upper prisms of a dioptric apparatus by the edge of the crater thus formed. In order to avoid this loss, and obtain the maximum of light from the carbon, they are usually so placed in the lamp that the axis of the bottom carbon is nearly in the same vertical plane as the front of the top carbon. This arrangement has the effect of sending a condensed beam of light of maximum intensity in one direction, and moreover the light is much steadier than with any other arrangement of the carbon points, in consequence of the current through the upper carbon being held steadily at the front edge. Mr. Douglass found with this arrangement of the carbons, and assuming the intensity of the light with the carbons having their axis in the same vertical line to be represented by 100, the intensity of the light in four directions in azimuth, say, E. W. N. and S., will be nearly as follows:—E. 287, N. and S. 116, W. 38. The mean intensity is thus as 139 to 100; but Mr. Douglas thinks that for lighthouse purposes a mean of E. (or front), N. and S. may be taken, giving a mean intensity of 173 to 100.

Mr. Douglas describes various experiments made to test the rival machines, and in an appendix the tabulated results of observations of the Siemens and Gramme machines are arranged. A series of experiments on January 18 on the power of light of the machines resulted as follows:—

	Mean condensed light.		Mean diffused light.	
	Standard candles.		Standard candles.	
1 Holmes M. E. machine	...	1,494	...	1,494
2 " "	...	2,721	...	2,721
1 Alliance " "	...	1,953	...	1,953
1 Gramme machine	...	5,333	...	3,215
2 " "	...	9,126	...	5,501

Next day measurements were taken of the light produced by the Siemens No. 1 and No. 58 machines. The light produced by the latter machine was tested against the light produced by the Gramme machine, and the light produced by one Holmes machine against that produced by No. 58 Siemens machine, the lamps being 100 feet apart. The results were as follows:—

With 1 Gramme *versus* No. 51 Siemens, the relative intensity was found to be as 100 to 100.6. With 1 Holmes *versus* No. 58 Siemens, the relative intensity was found to be as 100 to 384. The last two experiments



were checked by exchanging the conducting wires and lamps.

On January 20 the lights produced by the machines were tested against each other as follows, viz. :—1 Gramme *versus* No. 58 Siemens, 1 Holmes *versus* No. 1 Siemens, 1 Holmes *versus* 2 Grammes. An experiment was also made for determining the relative intensity of the light and horse-power absorbed by the Siemens No. 58 machine when running at half and full speed. With the machine running at half speed the light was found to be so unsteady that it could not be correctly measured.

The relative intensities of the light produced by the machines were as follows, viz. :—

1 Gramme <i>versus</i> No. 58 Siemens	as 100 to 116
1 Holmes „ No. 1 Siemens	as 100 to 557
1 „ „ 2 Grammes	as 100 to 663

On a subsequent day comparative trials were made of the two small machines of Messrs. Siemens, numbered respectively 58 and 68, when the intensity of the light was found to be as 100 for 58 to 109·5 for 68, being 9·5 per cent. in favour of the latter machine.

A trial was made of the two small Siemens machines, Nos. 58 and 68, working singly, and also together in parallel circuit. The intensities were found to be as follows, viz. :—

No. 58 Siemens machine	... ..	4,446
„ 68 „ „	... ..	65,63
For the two machines	... ..	11,009
Nos. 58 and 68 coupled together	... ..	13,179

There was thus shown to be a superiority in the intensity of the light produced by the two machines coupled together over that produced by the two machines when working singly, as 11,009 to 13,179, or as 100 to 119·7, being 19·7 per cent. more light with the two machines coupled together.

Experiments were also made for determining the relative intensities of the diffused beam of light with the carbons in the same vertical line, and of the condensed beam of light with the axis of the bottom carbon nearly in the same vertical plane as the front edge of the top carbon; also the intensities of the side and rear light. With the latter arrangement of the carbons the intensities were as follow, viz. :—

#### SIEMENS MACHINE, No. 68.

	Intensity. Standard in candles.
1. Carbons with axis in same vertical line	... 2,021
2. Axis of bottom carbon in same vertical plane as front edge of top carbon. Front beam	... .. 5,804
3. Same arrangement of carbons. Side beam, 90° from No. 2	... .. 2,346
4. Same arrangement of carbons. Back beam, 180° from No. 2	... .. 772

Messrs. Siemens having submitted for trial with their machines a conducting cable of larger dimensions than the South Foreland cables, and of the length required between the engine-room and the High Lighthouse, Mr. Douglass made some experiments with it in connection with each machine. The cable was 1,400 feet in length, and composed of 19 copper wires of No. 16 B.W. gauge well insulated. The cable was cut into two equal lengths of 700 feet each, and arranged in two coils in the engine-room. The currents from the Nos. 58 and 68 Siemens machines, separately and collectively, were sent through it to the electric lamp, which was also placed in the engine-room, and at a distance of 100 feet from the 6-wick oil test lamp. The short current to the lamp was made through 22 feet of the small cable of Messrs. Siemens, composed of seven copper wires of No. 13 B.W. gauge. The loss of light with the machines was found to be as follows, viz. :—

	Per cent. of the whole light.
No. 58 machine	... .. 24
No. 68 „	... .. 23
Nos. 58 and 68 coupled	... .. 35

The experiment previously referred to with the Siemens machine No. 58 showed a loss of light of about 43·8 per cent. with the current sent through 700 feet of the small lighthouse conducting cable. There would therefore appear to be a reduction in this loss of 43·8 less 24 = 19·8 per cent. by adopting the larger cable.

The results of these interesting and carefully-conducted experiments are entirely in favour of the small Siemens machine, which both Dr. Tyndall and Mr. Douglass recommend for adoption at the Lizard.

#### THE MOVEMENTS OF A SUBMERGED AQUATIC PLANT<sup>1</sup>

FOR a long time the researches of Dutrochet and Payer, taken up and continued by Duchartre, Sachs, and others, have familiarised botanists with the movements of torsion or of flexion presented by certain plants. Notwithstanding these conscientious researches this question is still one of the most mysterious problems in vegetable physiology. I propose to draw the attention of biologists to a fact of the same kind, which I believe new, and which is connected with the phenomena observed in phanerogamous aquatic plants, living entirely submerged. It relates to a well-known aquatic plant, *Ceratophyllum demersum*, which must be included among the number of those which, in certain of their parts, and at certain periods, spontaneously execute regular movements subject in their range to a well-marked periodicity.

It is known that the *Ceratophyllum* grows in the still water of ponds, and that its slender, branching, floating stems bear whorled leaves. Their ordinary position in stagnant waters is vertical, or nearly so. It is in the upper part of these stems (of those at least whose whorls are separated by about one or two centimetres) that these movements show themselves. They consist in the regular bending and straightening of the axis or of the branches, combined with a torsion more or less pronounced.

Taking the axis at its maximum of erection, it is seen to bend regularly, and with the peculiarities I shall indicate immediately, to curve more and more for about six hours, when it reaches its maximum of flexion; then straightening itself more gently, in twelve hours it resumes its original position; it next bends in the direction opposite to its first flexion, and in four hours it attains its maximum of inverse deviation, resuming its first position in four hours more.

Thus a young branch is vertical at 6 A.M., at its maximum of inclination at midday, perfectly straight again at midnight, inclined at the maximum towards the south at 4 A.M., vertical again at 8 A.M., at its maximum of inclination to the north at 2 P.M., quite erect at 2 A.M., inclined at the maximum to the south at 6 A.M., vertical at 10 A.M., and so on.

The total duration of an evolution will thus be about twenty-six hours. These oscillations, although nearly equal in duration, do not present at all ages of the plant the same extent nor the same amplitude. At first not well marked, but involving the entire axis, they become more and more pronounced with the age of the branch; then the lower internodes become successively immobile, and the terminal ones alone continue to move.

The branches of the *Ceratophyllum* present two different aspects. Sometimes the whorls are very close to each other, the internodes being very short; the leaves of the consecutive whorls, resting on each other, make with the stem a very acute angle and form a compact mass. Sometimes the internodes are elongated, the whorls are

<sup>1</sup> From an article in *La Nature*, by E. Rodier.